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Knowledge and Economic Growth: Evidence from Some Developing Countries

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Abstract: The purpose of this paper is to estimate the impact of Knowledge Index consist of R&D, human resources and diffusion of ICT on economic growth in developing countries. To do so we have used a sample of 16 developing countries for which the necessary data were available for the period 2000- 2008. In this paper knowledge economy index (R&D, human resources and diffusion of ICT), Investment (Gross fixed capital formation), general government consumption and labor force considered as explanatory variables and GDP as a dependent variable. Our findings based on panel data econometrics method indicate that the impact of knowledge index on economic growth in the countries under consideration is positive and significance. Therefore, the expansion of knowledge in these countries is suggested.

Keywords: *Knowledge; Economic Growth; Information & Communication Technology (ICT); Developing Countries, Panel Data.*

1. Introduction

Reaching high growth and economic development are among main goals that economic are following. The causes are profits and benefits that to be accomplished in growth process (such as promotion and improve of life level, decreasing poverty and unemployment). For this reason presented different growth theories. The purpose of growth is explaining the determiner factor of growth rates in one country and is the cause of differences of growth rates and per capita income between countries. The neoclassical growth models disregarded the entrepreneur and viewed knowledge as an exogenous factor (Braunerhjelm, 2007). For example, the neoclassical growth model of Solow (1956) focused on exogenous technological or population factors that determine output-input ratio. In this model the balanced path growth is achieved when the output and physical capital grow in tandem at the constant rate of the labor force growth (Jajri and Ismail, 2009). The empirical results of this model indicate that physical capital and labor inputs cannot explain the growth of output completely (Denison, 1962). Also on the basis of this model to give results same growth rate for all economies and this model has not ability to explain to cause of difference long-term growth rate between various countries. In answer to inadequacy of neoclassical growth models Lucas, Romer, Barro and other researchers design patterns that steady state growth can to be accomplished in the way of endogenous.

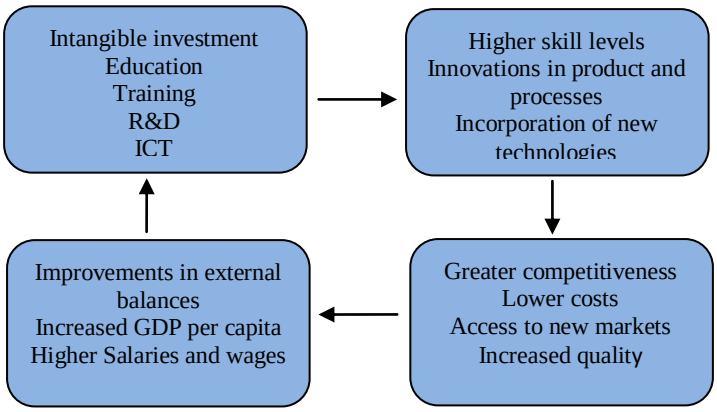
Lucas (1988) and Romer (1989), has identified a number of factors that determine the growth rate of an economy. Hence, factors such as increasing returns to scale, innovation, openness to trade, international research and development (R&D), and human capital formation are considered key factors in explaining the growth process (Lucas, 1988 and Turnovsky, 1999). Investments in education, invention, and related knowledge enhancing activities are seen to be the key factors to overcome the impact of the diminishing returns. Technological progress makes it possible to extract greater value from limited resources and sustain the economic growth over the long-term (Romer, 1986 and 1990; Lucas, 1988; and Karagiannis, 2007). The purpose of this study is to examine the relationship between knowledge economy index and economic growth in selected developing countries.In order to we used a panel data set consisting of the log of GDP for the 16 developing countries and a group of indicators (R&D, human resources and diffusion of ICT) that define the knowledge economy. The main hypothesis of the paper is that the effect of knowledge economy on economic growth is positive and significance. The paper is organized as follows: Section 2 the Knowledge economy framework and economic growth are discussed, section 3 presents the data and estimation method. Finally, Section 4 shows the findings and the main concluding remarks.

2. The Knowledge Economy Framework and Economic Growth

OECD (1996) defines knowledge economy as 'economies which are directly based on the production, distribution and use of knowledge and information'. Also Dahlman and Andersson (2000) defines knowledge economy as 'one that encourages its organizations and people to acquire, create, disseminate and use (codified and tacit) knowledge more effectively for greater economic and social development'. Derek, Chen and Dahlman (2004) described the four pillars of the knowledge economy as follows: *Educated and skilled workers* who can continuously upgrade and adapt their skills to efficiently create and use knowledge. In the other word a well-educated and skilled population is essential to the efficient creation, acquisition, dissemination and utilization of relevant knowledge, which tends to increase total factor productivity and hence economic growth. Globalization, meanwhile, is bridging the distance between basic skill needs and advanced skills, forcing countries to cover a wide educational band even at low levels of development to catch up with advanced economies and then remain competitive.

An effective *innovation system* of firms, research centers, universities, consultants, and other organizations that can keep up with the knowledge revolution and tap into the growing stock of global knowledge, assimilate and adapt it to local needs. Also, for most developing countries much of the knowledge and technology that nurtures innovation will originate from foreign sources, entering the country through foreign direct investment (FDI), imports of equipment and other goods, and licensing agreements (The World Bank, 2007). *A modern and adequate information infrastructure* that can facilitate the effective communication, dissemination, and processing of information and knowledge. ICTs are the essential parts of the knowledge economy and they have been recognized as an effective tool for promoting economic growth and sustainable development. ICT infrastructure refers to the accessibility, reliability and efficiency of computers, phones, television and radio sets, and the various networks that link them. Those can considerably reduce transaction costs by providing ready access to information. The ICT producing sectors have experienced major technological advancements, which have showed up as large gains in total factor productivity at the level of the economy.

Figure 1: Knowledge-Based Economy and Growth



Source: World Bank Institute, Knowledge for Development Program, 2007

3. Empirical Relationship between knowledge and Economic Growth

Present section attempts to classify the immense empirical literature relating economic growth with (a) R&D and investment in innovation (b) human resource development (c) ICT investments and Infrastructure and (d) knowledge and knowledge based economy. In the first group of studies: Both theoretical and empirical literatures have shown that investments in R&D (research and development) are crucial for economic growth. In the theoretical front, many models (Romer,1990 ; Grossman and Helpman, 1991; Aghion and Howitt, 1992) illustrate the function of R&D as a growth engine, and demonstrate the reason why government must have a role in achieving an optimum level of R&D (Pessoa, 2010). Also most of the empirical studies showed importance of R&D for economic growth (Griliches, 1992; Jones and Williams, 1998; Falk, 2007 and Goel *et al.*, 2008). In the second group of studies: human capital is included in the productivity estimations as "…knowledge, skills, competencies and other attributes embodied in individuals that are relevant to economic activity…"(OECD, 1998). Most empirical cross country studies that show a positive relationship between human capital and economic growth

include studies by Denison (1967), Barro (1990), Mankiw et al., (1992), Otani and Villanueva (1990), Hansen and Knowles (1998), Murthy et al., (1997), Barro and Lee (1996), Pritchett (1996) and Agiomirgianakis, at el., (2002).

A single-country study is always considered to have more advantages as compared to the cross-country studies. This is due to the fact that a long time series data for a single country can easily be gathered (Tallman and Wang, 1994). Furthermore the relationship between human capital and economic growth may change over time. Therefore, to capture this relationship, one may need a time series data. Among the studies for a single country that show a positive relationship between human capital and economic growth are Walter and Rubinson (1983); Tallman and Wang (1994); Lau, *et al.,* (1993); Fernandez and Mauro (2000) and Jajri and Ismail (2010). Among the empirical results that show a negative relationship between human capital and economic growth includes studies by Sacerdoti *et al*., (1998). In the third group of studies: a consensus exists in the important contribution of advanced ICT infrastructure in facilitating access to knowledge and promoting the spread of ideas (Karagiannis, 2007). Early macro level studies, going back to late 1980s and early 1990s, indicated that ICT's share in productivity and economic growth was very small (Roach, 1987; Oliner and Sichel, 1994; Jorgenson and Stiroh, 1995). However, later macroeconomic studies showed that investments in ICT had a considerable effect on economic growth (Jorgenson and Stiroh, 2000; Jorgenson, 2001; Dunn *et al.,* 2004; Piatkowski and Ark 2005; Hosseini and Aghaei, 2009).

Finally, in the third group of studies: Many cross-country empirics have shown that technological differences are the prime cause for differences in GDP per capita (Mankiw, Romer and Weil, 1992). The empirical growth literature emphasizes knowledge and the creation of knowledge via the activities of firms, households and the government in both R&D and education, as significant drivers for enhancing the level of technology (total factor productivity) (EC, 2005; Karagiannis, 2007). Dogan and *at el.*, 2005 argues that knowledge could become the main engine of growth if the economy establish certain preconditions. These preconditions include a sufficiently high level of quality in human capital stock, a high intensity of domestic innovation and technological adoption, well-established information and communications infrastructure, and the economic and institutional regime to stimulate productivity and economic growth. Also Karagiannis, 2007 find the positive effect knowledge-based economy consist of R&D effort, quality of human resources, innovation capacity, IT diffusion, access to finance & information society on economic growth.

4. Model, Data, and Estimation Methodology

We study the case of 16 developing countries* and use panel data for the period 2000 -2008. Data on GDP, Investment (Gross fixed capital formation), general government consumption, labor force, R&D expenditure, ICT expenditureand expenditure of public education in constant (2000 US $) prices are from WDI and UNESCO. The model to be estimated on panel data for 16 developing countries is based on a simple Cobb-Douglas production function.

$$GDP_i = EXP(\alpha_i) K_i^{\beta_1} L_i^{\beta_2} GY_i^{\beta_3} RD_i^{\beta_4} ICT_i^{\beta_5} EDU_i^{\beta_6} U_i^{\beta} \quad (1)$$

Where,
GDP is gross domestic product
L is labor force
K is gross fixed capital formation
GY is Exports of goods and services
RD is expenditure of Research and Developing
ICT is expenditure of Information and Communication Technology
EDU is expenditure of public education.
The model can be rewritten as follows:

$$ln(GDP_i) = \alpha_i + \beta_1 ln(K_i) + \beta_2 ln(L_i) + \beta_3 ln(GY_i) + \beta_4 ln(RD_i) + \beta_5 ln(ICT_i) + \beta_6 ln(EDU_i) \varepsilon_i \quad (2)$$

*The countries are Argentina, Chile, Colombia, Hungary, India, Indonesia, Iran Islamic Rep, Malaysia, Mauritius, Mexico, Peru, Philippines, Poland, Slovenia, South Africa, Thailand, and Turkey.

Tables 1: panel data estimation results for 2000-2008

Variables	Fixed effect		Random effect	
	Coefficient	t-Statistic	Coefficient	t-Statistic
Constant	3.856032*	20.43151	2.940577*	12.00117
lnK	0.22233*	17.33233	0.218266*	11.89428
lnL	0.254081*	10.56038	0.353173*	10.83283
lnGY	0.177465*	12.19864	0.161875*	7.548593
lnRD	0.032703*	2.126062	0.034522**	1.654986
LnICT	0.022389*	3.856117	0.015837**	1.883161
LnEDU	-0.0031	-0.37561	0.011562	0.801166
R2	0. 99		0. 95	
F-statistic	41298.9		337.7	

*Indicates significance at 5% level.
**Indicates significance at 10% level.

5. Findings and Concluding Remark

Based on regression results in table (1) all parameters estimated except education have the expected signs and are positive and statistically significance. Regarding the impact of knowledge economy indicators on economic growth the table indicates that the coefficient is positive and statistically significance at a 10 percent level. In other word the results support the importance role of the knowledge economy in economic growth of the countries under consideration. Therefore, it is suggested that the developing countries improve their performances in the so-called knowledge economy indicators such as the Educated and skilled workers, effective innovation system, modern and adequate information infrastructure, increase investment in Education, Training, R&D and ICT in order to achieve higher economic growth.

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